

Enclosures:

1

Your ref.:

Bingham Engineering,
165, Wright Brothers Drive,
Salt Lake City, Utah 84116,

Pentafax: 8015371182,
Cat Corporation,
SALT LAKE CITY,
U.S.A.

ATTENTION: Clark Mower.

Our ref.:
B0289160/19

Dict/type:
Sman/Fes
Datum:
1987.03.11.

3-11-87

Subject: Mayflower, consolidated Hazardous Waste Assessment.

Dear Clark,

In order to avoid delays in setting up your workplan, we are sending you the preliminary results of our study relating to the chemical analysis of soil and groundwater.

These results anticipate the final report of our study for the workplan for the consolidated Hazardous Waste Assessment Project for the tailings on the Mayflower Project Property. They identify specifically the chemical and physical analyses to be performed on selected water, soil, and tailings samples.

The proposed scenario, for chemical and physical analyses, depend heavily on the current appreciation of the site hydrodynamics and the position of the water table.

If the drilling of the first (exploration) hole down stream of the Ponds, as prescribed in our report B0-289160/9, 1987-2-2, indicates that there are no (shallow) water bearing strata, both the drilling locations and the required analyses should be reviewed and may be revised.

INTRODUCTION

To conduct the Hazardous Waste Assessment(s) for the site under consideration it is necessary to characterize the tailings, to identify the existing contamination and to be able to estimate future migration of the contaminants. In order to do this chemical and physical analyses of selected soil and water samples are required.

These analyses can be subdivided in groups according to the objectives of the sub-tasks in the workplan:

- characterize the tailings
- establish the actual groundwater quality for the metals identified as possible problems
- establish the actual groundwater quality for all relevant identified contaminants
- establish the database for computer aided estimates of future contaminant migration

CHARACTERIZATION

To characterize the tailings material a tailings (soil) sample from each of the three Mayflower Tailings Ponds and one from the Olsen-Neihart Reservoir will be analysed for total metal content. Additionally these samples will be analysed with X-ray defraction.

PROBLEM METALS

On the basis of existing information several metals have been selected as possible potential problem candidates. In order to establish a detailed picture of the migration of these contaminants all selected soil and water samples will be analysed for these metals, listed in table 1.

TABLE 1: major contaminants.

Arsenic
Cadmium
Chromium
Copper
Iron
Manganese
Lead
Zinc

OTHER CONTAMINANTS

In the current database there are a number of analyses of contaminants which do not indicate major problems. However, for completeness some soil and water samples will be analysed for the contaminants listed in table 2.

TABLE 2: other contaminants.

Aluminium
Barium
Boron
Cyanide
Gold
Magnesium
Mercury
Molybdenum
Nickel
Phenol
Selenium
Silver
Strontium

FUTURE MIGRATION

To estimate the potential migration of contaminants it is of importance to be able to estimate the pore water concentrations of key components. It is also necessary to establish the adsorption behaviour of these on the native soil and thus to determine the distribution coefficients for the contaminants under consideration.

The components listed in table 3 are to be analysed to facilitate this estimation.

TABLE 3: additional analyses.

Ammonia
Calcium
Carbonate
Chloride
Organic carbon
Potassium
Phosphate
Redox potential
Sodium
Sulphate
Sulphide
Sulphur total
Total alkalinity
Total Hardness

REQUIRED ANALYSES

As annex 1 we included the map indicating the suggested drilling locations, as included in our report B0-289160/9, 1987-2-2.

As annex A through E we include the required analyses to be performed on selected samples. Each annex is for a specific group of samples:



Page: 4
Ref.: B0289160/19
Date: 1987-03-11

- A - groundwater, limited analyses
- B - groundwater, total analyses
- C - pore water tailings
- D - native soil
- E - tailings material (solid)

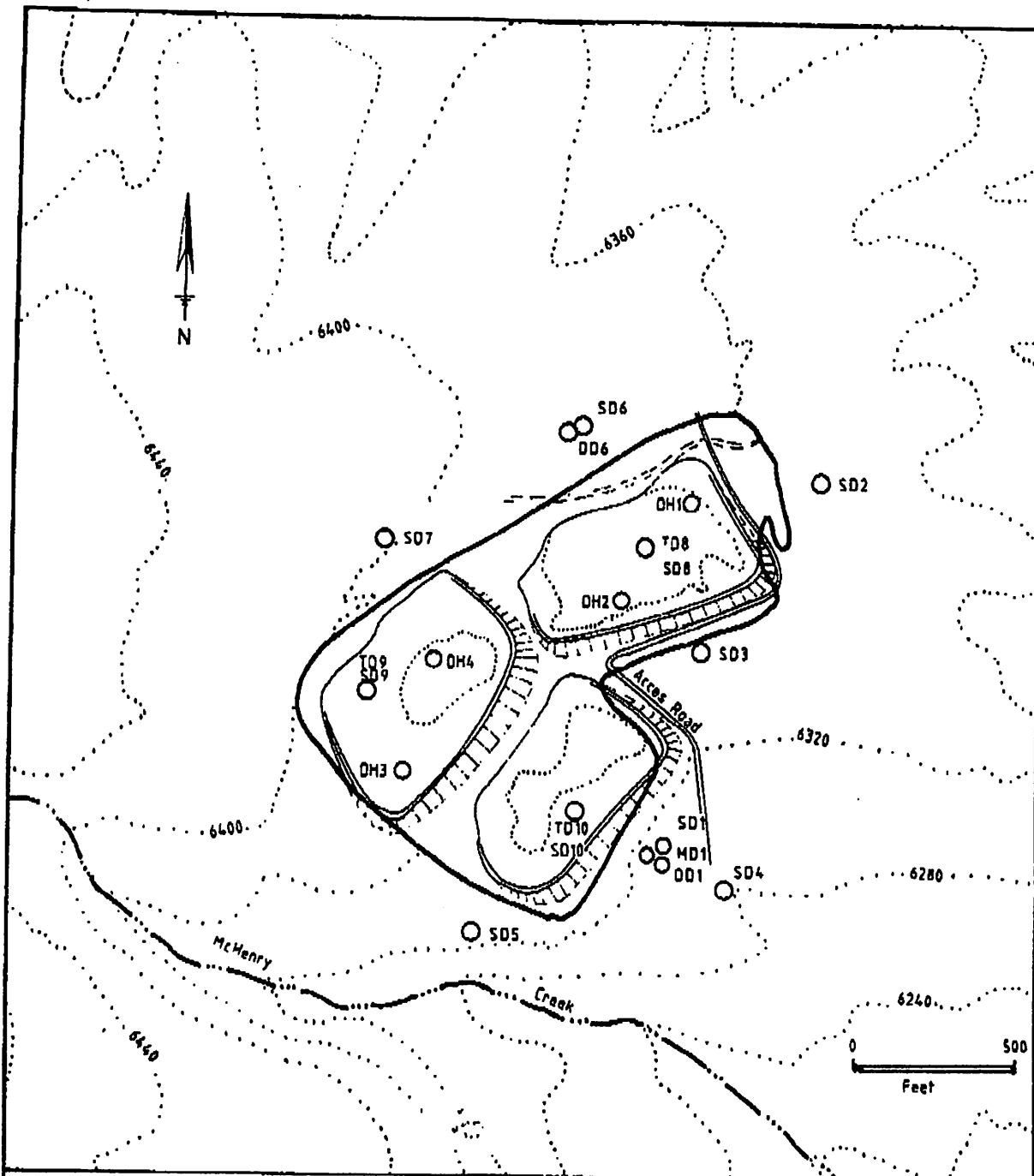
All analyses should meet the criteria as stated in "Evaluation Criteria for Existing Data from CERCLA Study Areas, guidance published by EPA, Region VIII in January 1985.

Yours faithfully,


DELFT GEOTECHNICS,

ir. H.T. Sman,

G.O. Arie Bogard.



- DH 4 = existing hole
- SD 1 = shallow drilled hole , location 1
- MD 1 = medium drilled hole , location 1
- DD 1 = deep drilled hole , location 1
- TD 10 = tailings drilled hole , location 10

 DELFT GEOTECHNICS	P.O. Box 69, 2800 AB Delft Holland Phone (015) - 569223 Holland	Telefax (015) 61 08 21 Telex 38234 soil n.	1987 - 03	7- E8
	MAYFLOWER PROJECT CONSOLIDATED MINE TAILINGS DRILLING LOCATION AND WELL NUMBERS		BO-289160	9- 90
			ANNEX 1	A4



Arsenic	As
Cadmium	Cd
Chromium (Hex)	Cr
Chromium (Tot)	Cr
Copper	Cu
Iron	Fe
Manganese	Mn
Lead	Pb
Zinc	Zn

ANNEX: B "total analyses".

Number of samples: 5
 Location numbers: SD1, MD1, DD1, DD6, SD10.
 (see annex 1)

Sample: (ground) water

Sampling

Intrusion of oxygen should be prohibited (by use of a down the well pump or "air" lift using nitrogen gas).
 Samples in polyethylene bottles (2 samples on each location).
 Samples to be filtered on site.
 After filtration nitric acid to be added to (1) one sample to pH = 2.

Required analyses

- on site (in situ)
 - Acidity
 - Electrical conductivity
 - Redox potential
 - Temperature

- laboratory (after filtration)

* sample with added nitric acid:

Arsenic	As
Cadmium	Cd
Chromium (Hex)	Cr
Chromium (Tot)	Cr
Copper	Cu
Iron (total)	Fe
Manganese	Mn
Lead	Pb
Zinc	Zn

Aluminium	Al
Barium	Ba
Magnesium	Mg
Mercury	Hg
Molybdenum	Mb
Nickel	Ni
Selenium	Se
Silver	Ag
Strontium	Sr

Boron	B
Calcium	Ca
Chloride	Cl
Fluoride	F
Potassium	K
Phosphate as P	PO ₄
Sodium	Na
Sulphate	SO ₄
Total dissolved solids	

* sample without additives:

Alkalinity as CaCO_3	
Ammonia	NH_3
Bicarbonate as	HCO_3
Carbonate as	CO_3
Carbon dioxide	CO_2
Carbonate solids	
Cyanide (total)	CN
Hardness as CaCO_3	
Iron (soluble)	Fe^{3+}
Nitrate	NO_3^-
Organic carbon	C
Phenol	-

ANNEX: C.

Number of samples: 3
 Location numbers: TD8, TD9, TD10.
 (see annex 1)

Sample: (pore) water

Sampling

Intrusion of oxygen should be prohibited (by use of a down the well pump or "air" lift using nitrogen gas).
 Samples in polyethylene bottles (2 samples on each location).
 Samples to be filtered on site.
 After filtration nitric acid to be added to (1) one sample to pH = 2.

Required analyses

- on site (in situ)

Acidity
 Electrical conductivity
 Redox potential
 Temperature

- laboratory (after filtration)

* sample with added nitric acid:

Arsenic	As
Cadmium	Cd
Chromium (Hex)	Cr
Chromium (Tot)	Cr
Copper	Cu
Iron (total)	Fe
Manganese	Mn
Lead	Pb
Zinc	Zn

Aluminium	Al
Barium	Ba
Magnesium	Mg
Mercury	Hg
Molybdenum	Mo
Nickel	Ni
Selenium	Se
Silver	Ag
Strontium	Sr

Boron	B
Calcium	Ca
Chloride	Cl
Fluoride	F
Potassium	K
Phosphate as P	PO ₄
Sodium	Na
Sulphate	SO ₄
Total dissolved solids	

* sample without additives:

Alkalinity as CaCO_3	
Ammonia	NH_3
Bicarbonate as	HCO_3
Carbonate as	CO_3
Carbon dioxide	CO_2
Carbonate solids	
Cyanide (total)	CN
Hardness as CaCO_3	
Iron (soluble)	Fe^{3+}
Nitrate	$\text{NO}_3\text{-N}$
Organic carbon	C
Phenol	-

ANNEX: D.

Number of samples: 4.
Location number: SD1, MD1, DD1, and SD10.
(see annex 1)

Sample: (native) soil

Sampling: from each location two (2) samples are required. One to perform the following analyses. The other will be used for tests to establish the adsorption behaviour of selected metals. This will be specified in a report with will be presented in due time.

Required analyses

- laboratory

Arsenic	As
Cadmium	Cd
Chromium	Cr
Copper	Cu
Iron	Fe
Manganese	Mn
Lead	Pb
Zinc	Zn
Aluminium	Al
Barium	Ba
Cyanide	CN
Gold	Au
Magnesium	Mg
Mercury	Hg
Molybdenum	Mo
Nickel	Ni
Selenium	Se
Silver	Ag
Strontium	Sr
Acidity	pH(KCl)
Alkalinity as	CaCO ₃
Calcium	Ca
Carbonate as	CO ₃
Organic carbon	C
Nitrate as	NO ₃ ⁻ N
Phosphate as P	PO ₄
Sulphate	SO ₄
Sulphide	S
Sulphur total	S

ANNEX: E.

Number of samples: 4.
Location number: TD8, TD9, TD10 and Olsen-Neihart.
(see annex 1)

Sample: (tailings) soil

Required analyses

- laboratory

Arsenic	As
Cadmium	Cd
Chromium	Cr
Copper	Cu
Iron	Fe
Manganese	Mn
Lead	Pb
Zinc	Zn

Aluminium	Al
Barium	Ba
Cyanide	CN
Gold	Au
Magnesium	Mg
Mercury	Hg
Molybdenum	Mb
Nickel	Ni
Selenium	Se
Silver	Ag
Strontium	Sr

Acidity	pH(KCl)
Alkalinity as	CaCO ₃
Calcium	Ca
Carbonate	CO ₃
Organic carbon	C
Nitrate as P	NO ₃ -N
Phosphate	PO ₄
Sulphate	SO ₄
Sulphide	S
Sulphur total	S

X-ray defraction

✓ *AKY*
3-31-87